

# PATENT ABSTRACTS OF JAPAN

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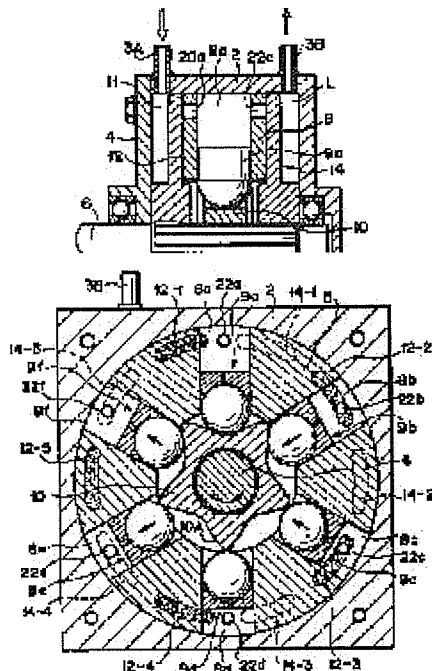
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## (54) RADIAL PISTON MOTOR AND RADIAL PISTON



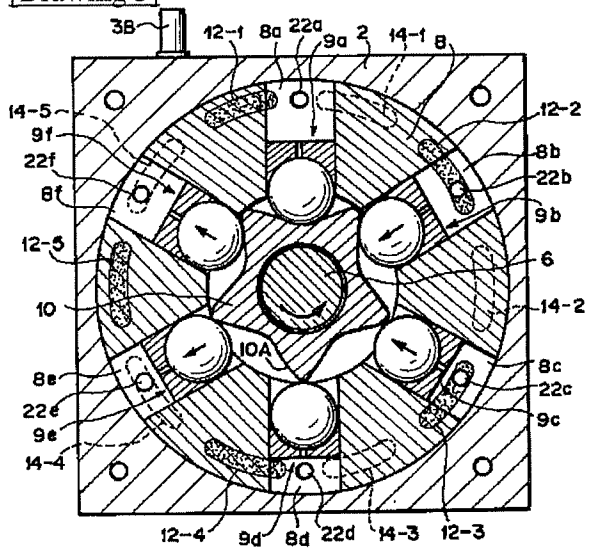
(57)Abstract:

PURPOSE: To simplify a motor and a pump in terms of structure by installing an energizing means, energizing a piston body inward to the radial direction of a turning shaft, in a cylinder. CONSTITUTION: When a high pressure fluid is fed to a high pressure fluid area H from a fluid inflow port 3A, pressing force or an energizing means energizing each of ball pistons(BP) 9b and 9c inward acts on them at each of cylinders 8b and 8c. On the other hand, the fluid is freely exhausted from a low pressure fluid area L via a fluid outflow port 3B, and at each of cylinders 8e and 8f, other ball pistons 9e and 9f become freed. Moreover, at other cylinders 8a and 8d being not yet interconnected to either of the high pressure fluid area H and the low pressure one L, other ball pistons 9a and 9d are maintained at the position intact. Accordingly, the ball pistons 9b and 9c is in a state of being shifted inward, and

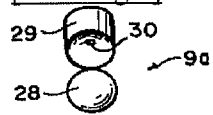
further the ball pistons 9e and 9f is in a state of being shifted outward, whereby the all piston 9a and 9d become almost the stopped state in the radial direction of a turning shaft. With this, this turning shaft 6 rotates counterclockwise to be shown in an arrow.



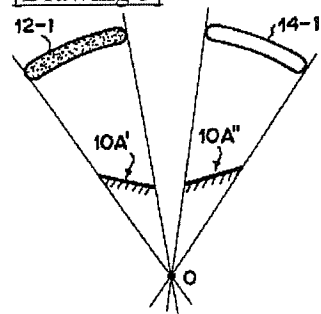
[Drawing 3]



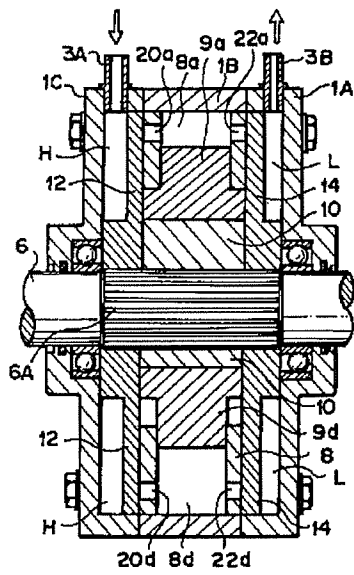
[Drawing 4]



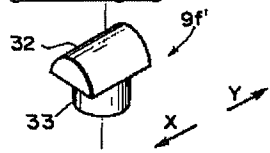
[Drawing 5]



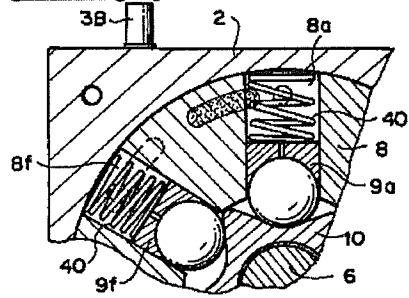
[Drawing 8]



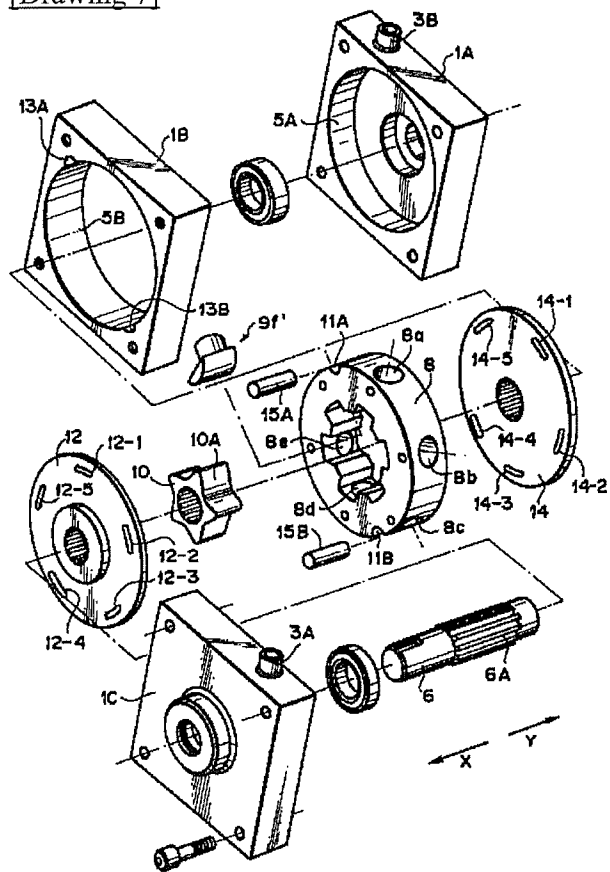
[Drawing 9]



[Drawing 6]



[Drawing 7]



## DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to a radial piston motor and a radial piston pump.

[0002]

[Description of the Prior Art] Although the radial piston motor and the radial piston pump are used conventionally, the further low-cost-izing and simplification of the structure for it are desired.

[0003] This invention aims at realizing simplification and low-cost-izing of the structure of a radial piston motor and a radial piston pump by adopting a new configuration.

[0004]

[Means for Solving the Problem] According to this invention, the revolving shaft is inserted into casing as what attains the above-mentioned object. The cam member which may be rotated is attached in these both revolving shafts, and the fluid supply side ports-plate member which may be rotated to said revolving shaft is attached in said one cam member sides of both about the shaft orientations of said revolving shaft. The fluid blowdown side ports-plate member which may be rotated to said revolving shaft is attached in both the another side sides of said cam member about the shaft orientations of said revolving shaft. In the way, the cylinder block is arranged about the direction of a path of said revolving shaft between said fluid supply side ports-plate member and said fluid blowdown side ports-plate member outside said cam member. This cylinder block is being fixed to said casing, and sliding of said fluid supply side ports-plate member and said fluid blowdown side ports-plate member is respectively enabled to the field of both sides about the direction of a path of said revolving shaft of said cylinder block. Two or more arrangement of the cylinder prolonged along the direction of a path of said revolving shaft in said cylinder block is carried out. Some piston objects [ at least ] are held in each of these cylinders. It is supposed that the contact to the cam side where the inside edge was formed in the periphery of said cam member about the direction of a path of said revolving shaft by both-way migration stroke within the limits within said cylinder is possible for this piston object. It is related with said cylinder block in the direction of a path of said revolving shaft from said both-way migration stroke range of said piston object in each cylinder. From an outside part to a sliding surface with said fluid supply side ports-plate member The fluid blowdown side stream through-hole prolonged to the sliding surface with the prolonged fluid supply side stream through-hole and said fluid blowdown side ports-plate member is formed. When rotating with said revolving shaft to said fluid supply side ports-plate member, said fluid supply side stream through-hole and two or more fluid supply side valve ports which can be open for free passage are formed. When rotating with said revolving shaft to said fluid blowdown side ports-plate member, said fluid blowdown side stream through-hole and two or more fluid blowdown side valve ports which can be open for free passage are formed. These fluid supply side valve port and a fluid blowdown side valve port Said fluid supply side stream through-hole, It is arranged in a location which is not open for free passage through said cylinder and said fluid blowdown side stream through-hole. To the hoop direction of said revolving shaft of said cam side One side goes up in said include-angle field in which the

surrounding include-angle field of said revolving shaft with which said fluid supply side valve port expects the center of rotation of said revolving shaft, and said fluid blowdown side valve port expect the center of rotation of said revolving shaft, and the meeting inclination is set as the appearance whose another side it is inclination and is a downhill grade. The field for high voltage fluids is formed between said fluid supply side ports-plate members and walls of said casing. The field for low voltage fluids is formed between said fluid blowdown side ports-plate members and walls of said casing. Said field for high voltage fluids and free passage \*\*\*\* fluid input are arranged at said casing, and said casing is provided with radial-piston-motor \*\* characterized by what said field for low voltage fluids and the free passage \*\*\*\* fluid tap hole are arranged for.

[0005] This invention sets like 1 voice and spline association of said cam member, said fluid supply side ports-plate member, and said fluid blowdown side ports-plate member is carried out by each to said revolving shaft.

[0006] This invention sets like 1 voice, said six cylinders are formed in said cylinder block, and what this cylinder adjoins about the hoop direction of said revolving shaft is making the include angle of 60 degrees mutually.

[0007] This invention sets like 1 voice, and said fluid supply side valve port and said five fluid blowdown side valve ports are formed in said fluid supply side ports-plate member and said fluid blowdown side ports-plate member, respectively, and let each of these valve ports be long and slender long holes in the hoop direction of said revolving shaft.

[0008] This invention sets like 1 voice and said cam side is making the shape of a column in accordance with the shaft orientations of said revolving shaft.

[0009] This invention sets like 1 voice, said piston object consists the ball section and this ball section of the acceptance \*\*\*\* piston section, and the contact to said cam side of said ball section is enabled.

[0010] It consists of the piston section connected to the pillar-shaped section in which it sets like 1 voice and said piston object is making the shape of a convex column in accordance with the shaft orientations of said revolving shaft and this pillar-shaped section of this invention, and said pillar-shaped section is not held into said cylinder, but the contact to said cam side is enabled, and said piston section is held into said cylinder.

[0011] Moreover, according to this invention, radial-piston-pump \*\* characterized by making it come to arrange an energization means to energize said piston object to the method of inside about the direction of a path of said revolving shaft as what attains the above-mentioned object in said cylinder of the radial piston motor like the above is offered.

[0012] This invention sets like 1 voice and said energization means consists of a compression coil spring arranged into the part outside said piston object about the direction of a path of said revolving shaft in said cylinder.

[0013]

[Example] Hereafter, the concrete example of this invention is explained, referring to a drawing.

[0014] Drawing 1 is the decomposition perspective view showing the 1st example of the radial piston motor by this invention, and drawing 2 and drawing 3 are the sectional view.

[0015] In these drawings, 2 is the casing main body section, 4 is the casing lid section, it is combined with a bolt, it is unified and these constitute casing. In the casing main body 2, the cavity 5 of the shape of a cylindrical shape of the symmetry of revolution centering

on the direction of X-Y is formed. In this cavity 5, the revolving shaft 6 of the direction of X-Y is arranged. Through the bearing, the direction edge of Y is supported by the casing main body section 2 so that it may be pivotable, through the bearing, the direction edge of X was supported by the casing lid section 4 so that it might be pivotable, and this revolving shaft 6 has extended out of casing. This revolving shaft 6 has spline 6A in the part in casing.

[0016] In the above-mentioned casing main body section cavity 5, the cylinder block 8 of an annulus ring configuration is arranged. This cylinder block 8 is being fixed to the casing main body section 2 with the bolt. A cylinder block 8 has an adaptation \*\*\*\* cylindrical shape-like peripheral face in the inner skin of the above-mentioned cavity 5, and has cylindrical shape-like inner skin further. Six cylinders 8a, 8b, 8c, 8d, 8e, and 8f are formed in this cylinder block 8 along the direction of a path of a revolving shaft 6 at the radial. The cylinders which these cylinders are uniformly arranged about the hoop direction of a revolving shaft 6, namely, adjoin are making 60 include angles mutually. These cylinders are penetrated and formed from the inner skin of a cylinder block 8 to the peripheral face, respectively. The penetration \*\*\*\* fluid supply side stream through-holes 20a, 20b, 20c, 20d, 20e, and 20f are formed in the location which corresponds to a cylinder block 8 with each above-mentioned cylinder from the cylinder concerned to the field by the side of X. Similarly, the penetration \*\*\*\* fluid blowdown side stream through-holes 22a, 22b, 22c, 22d, 22e, and 22f are formed in each above-mentioned cylinder and a corresponding location from the cylinder concerned to the field by the side of Y. These negotiation hole is prolonged in the direction of X-Y.

[0017] And in each above-mentioned cylinders 8a, 8b, 8c, 8d, and 8e and 8f, the ball pistons 9a, 9b, 9c, 9d, 9e, and 9f are arranged. Ball piston 9a consists of the ball section 28 and the piston section 29, and holds the globular form ball section 28 in the concave spherical surface formed in the end face of this piston section 29 as shown in drawing 4 . The side face of the piston section 29 is making the shape of an adaptation \*\*\*\* cylindrical shape to the inner surface of the above-mentioned cylinder. Moreover, the fluid channel 30 of the small cross section penetrated and prolonged in the ends face-to-face is formed in this piston section 29. Ball piston 9a is considered as the arrangement in which the ball section is located inside about the direction of a path of the above-mentioned revolving shaft 6, and the piston section is located outside as illustrated. It has other configurations and arrangement as the above-mentioned ball piston 9a also with the same ball pistons 9b, 9c, 9d, 9e, and 9f. [ the ]

[0018] the inner skin of the above-mentioned cylinder block 8 -- the cam member 10 is arranged further at the method of inside. This cam member 10 has spline 6A of the above-mentioned revolving shaft 6, and a \*\*\*\* spline hole in the center, and the cross-section configuration within the field which intersects perpendicularly with the direction of X-Y at a peripheral face is set to cam side 10A which makes stellate.

[0019] On the other hand, the direction end face of X of the above-mentioned cylinder block 8 is adjoined, and the fluid supply side ports-plate member 12 is arranged. This ports-plate member 12 has the above-mentioned revolving-shaft spline 6A and a \*\*\*\* spline hole in the center. In the direction location of the diameter of a revolving shaft equivalent to the fluid supply side stream through-holes 20a, 20b, 20c, 20d, 20e, and 20f of the above-mentioned cylinder block 8 in the periphery section The fluid supply side valve port 12-1 which consists of a long hole of the shape of radii



prolonged covering proper die length, 12-2, 12-3, 12-4, and 12-5 are formed in the hoop direction. The fluid supply side valve ports which these fluid supply side valve port is uniformly arranged about the hoop direction, namely, adjoin are arranged in the location which shifted 72 include angles mutually.

[0020] Moreover, the direction end face of Y of the above-mentioned cylinder block 8 is adjoined, and the fluid blowdown side ports-plate member 14 is arranged. This ports-plate member 14 has the above-mentioned revolving-shaft spline 6A and a \*\*\*\*\* spline hole in the center. In the direction location of the diameter of a revolving shaft equivalent to the fluid blowdown side stream through-holes 22a, 22b, 22c, 22d, 22e, and 22f of the above-mentioned cylinder block 8 in the periphery section The fluid blowdown side valve port 14-1 which consists of a long hole of the shape of radii prolonged covering proper die length, 14-2, 14-3, 14-4, and 14-5 are formed in the hoop direction. The fluid blowdown side valve ports which these fluid blowdown side valve port is uniformly arranged about the hoop direction, namely, adjoin are arranged in the location which shifted 72 include angles mutually.

[0021] As shown in drawing, the fluid supply side valve port and the fluid blowdown side valve port are considered as the arrangement which shifted only 36 include angles exactly about the hoop direction. and as for a fluid supply side valve port and a fluid blowdown side valve port, the fluid blowdown side stream through-holes 22a and 22d etc. do not lap among them about a hoop direction so that drawing 3 may show (fluid supply side stream through-holes 20a and 20d etc.) -- it is isolated as it can be located like.

[0022] In casing, the field H for high voltage fluids is formed at the X side of the above-mentioned fluid supply side ports-plate member 12, and the field L for low voltage fluids is formed in the Y side of the fluid blowdown side ports-plate member 14. And high voltage fluid input 3A is formed in the casing main body section 2 so that it may be open for free passage with the above-mentioned field H for high voltage fluids, and fluid tap hole 3B is connected so that it may be open for free passage with the above-mentioned field L for low voltage fluids.

[0023] The relation between a hoop direction and the location of the configuration of cam side 10A of the above-mentioned cam member 10, a fluid supply side valve port, and a fluid blowdown side valve port is shown in drawing 5 . In drawing 5 , O shows the center of rotation of a revolving shaft 6. That is, drawing 5 is the schematic diagram seen in the direction of a revolving shaft like drawing 3 . Two straight lines which connect the hoop direction ends and the center of rotation O of the fluid supply side valve port 12-1 are drawn. When two straight lines which connect the hoop direction ends and the center of rotation O of the fluid blowdown side valve port 14-1 are drawn In the surrounding include-angle field of the revolving shaft O two straight lines' about the fluid supply side valve port 12-1 pinched, cam side 10A' of a cam member goes up about the direction of the circumference of an anti-clock, and inclination is made. In the surrounding include-angle field of the revolving shaft O two straight lines' about the fluid blowdown side valve port 14-1 pinched, the configuration of cam side 10A is set up so that cam side 10A" of a cam member may make a downhill grade about the direction of the circumference of an anti-clock. It is the same also about other fluid supply side valve ports and a fluid blowdown side valve port.

[0024] Thereby, while each cylinder is open for free passage with the high voltage fluid field H through a fluid supply side stream through-hole and a fluid supply side valve port,

the turning effort of the circumference of an anti-clock is always given to the cam member 10 by the ball piston. The ball piston in the low voltage fluid field L and a cylinder open for free passage is freely movable to the method of outside about the direction of the diameter of a revolving shaft in that case. Therefore, the revolving shaft 6 which is carrying out spline association with the above-mentioned cam member 10 is made to rotate by the circumference of an anti-clock. The fluid supply side ports-plate member 12 which is carrying out spline association with this revolving shaft 6, and the fluid blowdown side ports-plate member 14 are made to rotate with a revolution of this revolving shaft 6 by the circumference of an anti-clock.

[0025] In this example equipment, the physical relationship of the hoop direction between the configuration of cam side 10A of the cam member 10, the fluid supply side valve port 12, and a fluid blowdown side valve port is shown in drawing 3 .

[0026] That is, in cylinder 8a, ball piston 9a is located in the innermost side of the both-way migration stroke range within a cylinder, and the ball section is located in the 1st trough of the stellate configuration of cam side 10A. Moreover, the negotiation holes 22a and 20a corresponding to cylinder 8a are not open for free passage with a fluid blowdown side valve port and a fluid supply side valve port, respectively.

[0027] In cylinder 8b, ball piston 9b is displacing from the innermost side to the method of outside in the direction of the diameter of a revolving shaft, and it is located in the place beyond the 1st Yamabe by whom the ball section adjoins the 1st trough of the above of the stellate configuration of a cam side. And although negotiation hole 22b corresponding to cylinder 8b is not open for free passage with a fluid blowdown side valve port, negotiation hole 20b corresponding to cylinder 8b is open for free passage with the fluid supply side valve port 12-2.

[0028] In cylinder 8c, ball piston 9c is displacing to the method of outside in the direction of the diameter of a revolving shaft further, and it is located in the place beyond the 2nd Yamabe who adjoins the 2nd trough by which the ball section adjoins the 1st Yamabe of the above of the stellate configuration of a cam side. And although negotiation hole 22c corresponding to cylinder 8c is not open for free passage with a fluid blowdown side valve port, negotiation hole 20c corresponding to cylinder 8c is open for free passage with the fluid supply side valve port 12-3.

[0029] In cylinder 8d, ball piston 9d is located in an outermost part, and it is located in the 3rd Yamabe who adjoins the 3rd trough by which the ball section adjoins the 2nd Yamabe of the above of the stellate configuration of cam side 10A. And the negotiation holes 22d and 20d corresponding to cylinder 8d are not open for free passage with a fluid blowdown side valve port and a fluid supply side valve port, respectively.

[0030] In cylinder 8e, ball piston 9e is displacing from the outermost part to the inner direction in the direction of a path, and it is located before the 4th Yamabe who adjoins the 4th trough by which the ball section adjoins the 3rd Yamabe of the above of the stellate configuration of a cam side. And although negotiation hole 22e corresponding to cylinder 8e is open for free passage with the fluid blowdown side valve port 14-4, negotiation hole 20e corresponding to cylinder 8e is not open for free passage with a fluid supply side valve port.

[0031] In cylinder 8f, ball piston 9f is displacing to the inner direction in the direction of a path further, and it is located in the place beyond the 5th trough by which the ball section adjoins the 4th Yamabe of the above of the stellate configuration of a cam side.

And although 22f of negotiation holes corresponding to cylinder 8f is open for free passage with the fluid blowdown side valve port 14-5, 20f of negotiation holes corresponding to cylinder 8f is not open for free passage with a fluid supply side valve port.

[0032] In this example, if a high-pressure fluid (for example, oil) is supplied from fluid input 3A to the field H for high voltage fluids, in this field H for high voltage fluids, and a cylinder (it sets to drawing 3 and they are 8b and 8c) open for free passage, thrust will act to the method of inside to a ball piston (it sets to drawing 3 and they are 9b and 9c), respectively. On the other hand, since he is trying to be freely discharged from the field L for low voltage fluids in a fluid through fluid tap hole 3B, in the field L for low voltage fluids, and a cylinder (it sets to drawing 3 and they are 8e and 8f) open for free passage, the ball piston (it sets to drawing 3 and they are 9e and 9f) is free. Furthermore, although a ball piston (it sets to drawing 3 and they are 9a and 9d) is maintained in the location in the cylinder (it sets to drawing 3 and they are 8a and 8d) which any of the field H for high voltage fluids and the field L for low voltage fluids are not opening for free passage Since the path directional movement of the ball piston accompanying the revolution per unit include angle of the cam member 10 is very small here, the resistance force to the revolutions of the cam member 10 is remarkably small.

[0033] Therefore, in drawing 3, as the ball pistons 9b and 9c show by the arrow head, it is in the migration condition to the method of inside, as the ball pistons 9e and 9f show by the arrow head, it is in the migration condition to the method of outside, and the ball pistons 9a and 9d are in a idle state mostly about the direction of the diameter of a revolving shaft. Thereby, a revolving shaft 6 is made to rotate, as an arrow head shows by the circumference of an anti-[ in drawing 3 ] clock. And the fluid supply side ports-plate member 12 and the fluid blowdown side ports-plate member 14 are also simultaneously rotated with this revolving-shaft revolution.

[0034] In addition, in this example, fields between structural members other than the field H for high voltage fluids in the above-mentioned casing and the field L for low voltage fluids are also filled up with the fluid (oil). And through the fluid channel 30 of the piston section 29 of the ball piston shown in above-mentioned drawing 4, the fluid negotiation based on a fluid pressure difference is made, and, thereby, a lubrication function is realized.

[0035] Drawing 6 is the fragmentary sectional view showing one example of the radial piston pump by this invention. This Fig. shows the same part as above-mentioned drawing 3. In this Fig., the same sign is given to the same member also in drawing 3.

[0036] It is only different from the radial piston motor of the 1st example of the above that this example has arranged the energization means slack compression coil spring 40 which energizes ball pistons (9a etc.) to the method of inside about the direction of a path of a revolving shaft 6 inside each cylinders (8a etc.) on structure. The compression coil spring 40 is arranged about the direction of the diameter of a revolving shaft in a cylinder at the part outside a ball piston as illustrated.

[0037] Therefore, a fluid can be made to be able to inhale to casing through fluid input 3A, and a fluid can be made to be able to breathe out through fluid tap hole 3B from casing, and a pump action can be made to perform in this example by carrying out revolution actuation of the revolving shaft 6 from the exterior.

[0038] Drawing 7 is the decomposition perspective view showing the 2nd example of the

radial piston motor by this invention, and drawing 8 is the sectional view. In these drawings, the same sign is given to the member which has the same function also in above-mentioned drawing 1 - drawing 6 .

[0039] In this example, three, 1A, 1B, and 1C, are used as a member which constitutes casing, and the cavities 5A, 5B, and 5C (it has not appeared in drawing) of the shape of a cylindrical shape of the symmetry of revolution centering on the direction of X-Y are formed in the interior of these members, respectively. Moreover, in this example, the ends of a revolving shaft 6 have extended out of casing. It is combined with a bolt, it is unified and these configuration members 1A, 1B, and 1C constitute casing.

[0040] Although the configuration of the cam member 10, the fluid supply side ports-plate member 12, and the fluid blowdown side ports-plate member 14 is equivalent to the 1st example, the configurations of a cylinder block 8 differ the 1st example and a little. That is, the inner skin of a cylinder block 8 does not have the shape of a simple cylindrical shape, and the key ways 11A and 11B of the direction of X-Y are formed in the peripheral face. These key ways 11A and 11B are making Keys 15A and 15B intervene, respectively among the key ways 13A and 13B formed in the inner skin of the above-mentioned casing configuration member 1B, and since a cylinder block 8 is fixed to casing, they are used.

[0041] Furthermore, the piston object (for example, 9f') which achieves the function equivalent to the ball pistons 9a-9f of the 1st example of the above that it is characteristic in this example It consists of the piston section 33 connected to the pillar-shaped section 32 which is making the shape of a convex column in accordance with the shaft orientations (the direction of X-Y) of a revolving shaft 6, and this pillar-shaped section as shown in drawing 9 . It is that the pillar-shaped section 32 is not held into a cylinder, but the contact of it is enabled at cam side 10A, and the piston section 33 is held into a cylinder. Therefore, in this example, since the pillar-shaped section 32 and cam side 10A carry out line contact, sliding contact pressure is reduced and wear can be lessened.

[0042]

[Effect of the Invention] As mentioned above, according to this invention, the radial piston motor and radial piston pump of a new configuration of fixing a cylinder block and rotating a ports-plate member with a cam member are offered, and, thereby, simplification and low-cost-izing of the structure of a radial piston motor and a radial piston pump are realized.